Digitalization of the agricultural sector in Kazakhstan

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Abstract. The agrarian sector of Kazakhstan's economy is dynamically developing in the system of market relations. The system of market relations, production and economic relations are transformed, new forms of interaction between the subjects of the agrarian sector are used. Today, agrarians are actively using information technologies to improve production efficiency. They see the importance of digitalization of agribusiness, the advantages of information technology implementation in practice. Ultimately, the digitalization of the studied sphere of economy will ensure the normal functioning of the industry. In order to ensure efficient production, any enterprise is interested in reducing the costs associated with the production of crop and livestock products. The agricultural products produced for consumers must also meet the required quality characteristics and withstand competition in the market. And this can be achieved only through intensive factors of production and digitalization of agro-industrial complex. The need to implement digital technologies in the sphere of agriculture is the purpose of writing this study.

1 Introduction

Digitalization usually implies the use of technologies that transform operational models and the global economy as a whole by replacing or supplementing humans through the use of advanced analytics, artificial intelligence, mobile devices, robotization and integration technology platforms, as well as advanced communication standards [1].

Digitalization has an impact on all spheres of the world economy. All countries are involved in it, and Kazakhstan is no exception. The competitiveness of our country directly depends on how widely we use digital technologies in the domestic economy. Digitalization in Kazakhstan has entered all spheres of our life.

Digital technologies cover most spheres of human activity. The emergence and application of digital technologies agricultural producers have the opportunity to monitor the production process in agriculture. "Smart" devices measure and transmit parameters of soil, plants, microclimate, etc. All this data from sensors, drones and other equipment is analyzed by special software. Mobile or online applications help farmers and agronomists

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to determine the favorable period for planting or harvesting, calculate fertilizer application schemes, and predict the right time for harvesting [2].

2 Materials and Methods

While writing this article various methods of economic research were used, such as methods of abstract-logical, synthesis and analysis, monographic methods to determine the need for digitalization of the agrarian sector of the economy and highlighting the advantages of digitalization of the agro-industrial complex of Kazakhstan.

3 Results and Discussion

The digitalization of agribusiness is considered one of the factors that plays a crucial role in the innovation of food supply. In this regard, agrarians should set and solve the following challenges. Namely:

- to produce as much crop production as possible per unit area of arable land;

assess the risk of yield reduction or crop failure, and, most importantly, take all possible measures to minimize the risk;

- all production costs should be minimized;
- agricultural products should be sold at the highest possible price.

Predicting optimal sowing and harvesting times, smart irrigation and fertilization, and intelligent pest control systems significantly increase productivity.

Digital transformation is driving organizations to constantly organizations to constantly update their business models, and much of the change will be accomplished using new technologies. Modern agro-technologies differ from existing technical solutions in the speed with which they can scale up and expand into global markets, and the disruptive nature of the business, whereby new start-ups can replace established businesses by offering more competitive services (in terms of price, quality, usability) [3].

The prerequisites for the digitalization of the agro-industrial complex were:

- Territorial. Climatic and resource conditions of agricultural production, the way of thinking of many workers in the agricultural sector.
- legal. Lack of regulations related to the transfer of innovative developments in the agricultural sector, lack of adequate standards in the field of digitalization of the agro-industrial complex.
- Institutional. Research activities on digital transformation in the agricultural sector, lack of a situation center for implementation and control.
- Structural. Throughout the production chain effective in the creation of logistics infrastructure in the agricultural sector, lack of government support. In the digital ecosystem, ineffective for safety and quality of agro-industrial products
- information. lack of reliable information about the situation in the agro-industrial complex and food market, and, as a consequence, unreasonable planning, insufficient quantity and quality of research, domestic developments in the field of digitalization of agriculture.
- Resource. Migration of people from rural areas to cities or neighboring cities, the level of qualification of domestic specialists in the agro-industrial complex is low.

More effective development of the agricultural sector in the Republic of Kazakhstan is largely hindered by underdeveloped infrastructure and irrigation systems, limited access to the latest technologies and financing, as well as imperfect methods of agro-industrial production management.

In market conditions intensification of innovation activity should be considered as a strategic direction of agricultural production development [4,5].

Due to the negative impact of the country's harsh climate, agriculture faces increased risks, so Kazakhstan needs to move more actively towards precision agriculture. Currently digitalization of the agro-industrial complex of the country is manifested in the introduction and widespread use of GPS technology. introduction and wide use of GPS navigation technology, unmanned aerial vehicles, electronic maps and parallel driving systems. These technologies make it possible to maintain precise trajectories when plowing and sowing, increase labor productivity and reduce fuel consumption.

On the basis of applied elements of precision agriculture, three levels of digitalization of the agrarian sphere of the Republic of Kazakhstan:

- The basic level is a conventional farm with a practically traditional approach to farming, using soil analysis and electronic field maps. analysis and electronic field maps.
- The advanced level is represented by partially automated farms, which need to apply business processes, sensors of fuel and lubricants consumption, etc. fuel and lubricant sensors, trackers, electronic weed maps.
- digital farms - operate with little or no human involvement due to new tools and technologies.

Currently, there are about 170 advanced and more than 20 digital farms operating in Kazakhstan. 20 digital farms. According to official data, almost 100% of sown areas of the Republic of Kazakhstan have been digitized, i.e. an electronic map has been created of fields with a total area of about 24 million hectares [6].

Digital technologies in agribusiness provide benefits such as:

- help implement regulatory principles and monitoring techniques to improve operations;
- new technologies for agricultural producers in the organization and management of the enterprise;
-With the help of new technologies in the sphere of financial services, agricultural producers can open deposits, insure their property, life and health;
-Monitoring with the use of new technologies allows agricultural products to meet the required quality parameters;
- With the help of information technologies it is possible to conduct training seminars to improve digital and financial literacy of agricultural producers/

Consider the types of digital technologies for agriculture

1.Computing equipment (desktop computers, monoblocks, laptops and tablets) in economic, economic activities is used for bookkeeping, collection of data of traditional and digital format, in other words, collected with the help of other digital tools. With the help of computing technology, the required amount of resources (seeds, machinery, pesticides, fertilizers, building materials, etc.) is calculated, the total budget of the peasant farm is planned, investment projects are developed and their effectiveness is calculated. Computational technology also helps to make calculations for technological processes such as irrigation, feeding, crop rotation. In conjunction with other digital tools, the computer monitors the location and physical condition of animals. Together, these functions help to significantly reduce the amount of material and labor resources consumed.

2. Smartphones (functions and applications). The functions of a smartphone used in agriculture are similar to the above mentioned computing technology, the difference being less power resources and much greater mobility. Smartphone software is closely related to with all other technologies and allows online monitoring of the farm. The latest mobile applications make it possible to make assumptions about the state of health of animals and plants based on photos, which significantly saves time spent by specialists to prevent and detect diseases. (https://elibrary.ru/item.asp?id=46663288). Currently, smartphones and

their applications have become an important tool for many farmers to communicate, trade; collect, store, transmit and process data for management decisions, thus optimizing trade, economic and analytical processes within farms and communities.

3.Web platforms (communities, e-governance). In the modern world, it is critical for workers in any sphere of economy, including agribusiness, to have access to the most up-to-date information on the development of new technologies, methods and scientific achievements in their sphere to ensure sustainable and intensive development of their farms. Such sources are a number of web platforms of various types: electronic collections, electronic collections, databases, electronic libraries, electronic catalogs, electronic journals, Internet portals, forums (https://cyberleninka.ru/article/n/informatsionnye-resursy-internet-dlya-spetsialistov-selskogo-hozyaystva).

It is important to note that many of the platforms in Kazakhstan and the CIS as a whole are at the initial stage of their development. One of the key projects in this area could be the creation of a digital platform of commodity distribution systems at the regional, republican and inter-country level.

4. Remote sensing (satellites, airplanes, drones) and sensors (weather, GPS). Effectively used to quantify crop health. Sensors can serve as early warning systems to counteract climatic or biological aberrations before they negatively affect crop yields. Remote sensing applications play an important role in agriculture for assessing plant health, estimating crop yields and yield losses, irrigation management, detecting plant stress, detecting weeds and pests, weather forecasting, collecting phenological information on crops, etc. Yield management using remotely sensed data combined with crop development simulation models is becoming more and more popular day by day due to its potential advantages. Remote sensing reduces the amount of field data collection and improves the accuracy of estimates. Monitoring vegetation cover to estimate crop acreage, mapping and monitoring drought conditions and maintaining vegetation health, assessing crop health under stress conditions, checking nutrient and moisture status in the field, measuring crop evapotranspiration, controlling weeds with a precision agriculture, collection and transmission of atmospheric dynamics forecasts through various observation satellites are the major applications of remote sensing technologies in agriculture Thus, remote sensing allows collecting more accurate information for analysis and building development strategies, and significantly reduces labor costs compared to classical research and monitoring methods.

5. Sensors (weather, GPS tags, livestock). Sensors (weather, GPS tags, livestock). Thanks to modern technology, it is now possible to manage livestock in a rational way. It is possible to remotely detect animal diseases, their condition, identify problems in their activity by means of accelerometers in real time. In addition, it is possible to notify agricultural producers about the situations that have arisen so that they can take timely and prompt action.

6. Robotics (agricultural robots, unmanned tractors). At the heart of the crop production process are field operations that are quite labor intensive, either because of their complexity, because they involve the interaction of sensitive plants and foodstuffs, or because of the repetitiveness they require throughout the crop cycle. These are key factors for the development of agricultural robots. Robotic systems that are most advanced are those related to harvesting and weeding, such as unmanned vehicles and sorting, while robots for disease detection and seeding are still in the early stages of development.

Optimization and further development of agricultural robotics is vital and should be developed by creating faster processing algorithms, improved communication between robotic platforms and implements, and advanced sensor systems (https://doi.org/10.3390/s20092672. https://www.mdpi.com/1424-8220/20/9/2672).

Of course, in the realities of Kazakhstan and taking into account the relatively low level of labor remuneration, the introduction of some solutions of this type of technology is economically unprofitable at the moment. Instead, such partial solutions as GPS-trackers are introduced, which help the tractor driver to choose the optimal trajectory, prevent overlapping of the route and improper use of equipment. However, in the near future, taking into account the development and cheapening of technological equipment, it may start to be implemented more widely.

7. Cloud technology (data storage and processing, Big Data). The use of cloud computing technology in agricultural areas has great prospects for the intensification of the agro-industrial complex industry. Cloud computing eliminates the need to maintain expensive computing hardware, software, information technology, personnel, infrastructure, resources and their maintenance. Cloud computing is a networking environment focused on sharing computing, cloud computing networks access to a common pool of customized networks, servers, storage, services, applications and other critical computing resources. In the modern era, cloud computing technologies are useful for a centralized bank of agricultural data linked in a single cloud: soil, weather, research, crops, farmers, agricultural marketing, fertilizer and pesticide information (https://core.ac.uk/download/pdf/234645129.pdf). This type of technology directly relies on the level of development of other areas of digitalization. Due to the initial level of their development in general, it is considered only as a promising for implementation. At the same time, the Government of Kazakhstan is already considering the creation of an agro-industrial complex situation-analytical center in the Ministry of Agriculture of the Republic of Kazakhstan using cloud technologies and machine learning (see below).

8. Artificial Intelligence (machine learning). Artificial Intelligence in agriculture can revolutionize agriculture. This technology can be used to protect crop production from climate impacts, demographic growth, employment difficulties and food safety. It can be used in agriculture, e.g. for irrigation, weeding, spraying with the help of sensors and other means embedded in robots and drones (https://www.sciencedirect.com/science/article/pii/S258972172030012X). This type of technology is at the stage of development and initial level of implementation not only in Kazakhstan, but also in the world as a whole.

9. Blockchain (transactions). Blockchain is a database of records and transactions that are recorded and stored by all participants. It collects and stores accurate information about the status of farms, stocks and contracts in the agribusiness sector. With this technology, blockchain monitors the origin of food products and creates trusted relationships between buyers and sellers of food products. [7].

Obtaining all possible benefits by agricultural producers is hindered by factors that continue to be overcome to this day:

1) Unstable and irregular Internet connection in rural areas.

2) Lack of unified standards of various manufacturers of equipment and software for digitalization of agro-industrial complex.

3) Poor quality of communication in rural areas compared to urban areas at the same price.

4) Limited integration into market chains and limited decision-making power

5) Conservative attitude of farmers towards new technologies.

6) Low awareness of farmers about digital technologies in agriculture and the benefits of their adoption.

4 Conclusion

To improve the efficiency of digitalization, the modernization of the information infrastructure of the agro-industrial complex requires as the main factors:

1. providing full access to the Internet in all places, automation of production processes, robotics, artificial intelligence, exchange of "big data", etc. input.

2. Development of digital competence of farmers and agro-industrial complex determination of the need for specialists, providing training and retraining on profile educational programs using the best world experience in higher educational institutions of the agricultural sector.

3. Adaptation of production to climate change for the purpose of informed management of agricultural risks and increasing productivity of crops and livestock.

4. Finding new mechanisms and forms of public-private partnerships to scale up agribusinesses

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